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By-Saslaw, Milton S.

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In the program Motivation in Depth for Gifted High School Science Students" initiated in 1964, specially selected seventh grade students took in successive summers Biological Sciences Curriculum Study (BSCS), Chemical Education Materials Study, (CHEMS), and Physical Science Study Committee (PSSC) courses; a newly designed course, Laboratory Orientation and Instrumentation; and two academic years in the Laboratory Research Program. Evaluation was to determine program feasibility, collect selected data, and analyze differences between the experimental students and matched control students on the California Occupational Interest Inventory (COII). Feasibility was demonstrated by these observations: (1) 91.7 per cent of all class performances met school requirements; (2) participating students in BSCS and PSSC obtained scores on national tests more favorable than national controls; (3) participants performed satisfactorily compared with controls who took the regular academic program in tenth, eleventh and twelfth grades. Data have been collected over the duration of the program by the Wechsler Intelligence Scale for Children and specially constructed structured interviews, and by group Rorschach, Bell Personality Inventory and COII. Analysis of the COII revealed a significant increase in the difference between experimental and matched control students in the personal-social factor. (GR)

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Milton S. Saslaw, M.D., M.P.H.

University of Miami Graduate School
Coral Gables, Fla.

June 1968

The research reported herein was performed pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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Mrs. Charlotte Simka served as my administrative secretary. Without her efforts, confusion would have prevailed.

Summary:

Under NSF support, an operational program, "Motivation in Depth for Gifted High School Science Students" was initiated in 1964. Specially selected seventh grade students took BSCS, CHEM S and PSSC courses during successive summers after seventh, eight and ninth grades; a newly designed curriculum, Laboratory Orientation and Instrumentation after tenth, followed by eleventh and twelfth academic years in the Laboratory Research Program (implemented in 1957). The present USOE contract is to support evaluation of the operational project. The Dade County School System and the Graduate School of the University of Miami furnished the facilities and much of the personnel.

The evaluation protocol set three objectives: feasibility; data collection; appraisal of the California Occupational Interest Inventory in selection of students likely to choose scientific careers.

Feasibility was studied on the basis of predefined criteria, (1) that "standard achievement scores will indicate successful accomplishment of at least 80 per cent of students selected to participate in the present program"; (2) that "standardized scores in the experimental groups are equal to or higher than those achieved by C_2 group or above national norms"; (3) that "school grades in science and non-science academic subjects will be higher in the experimental than in the control group"; and (4) that "students in the experimental group show increased interest in science and non-science academic subjects, when compared with control (C_1) matched pairs".

Our results showed that 81.3 per cent of all final school grades were A or B, 16.7 per cent were C, and only 2 per cent were lower.

On national tests, about 16 per cent of students may be expected to score lower than the average minus one standard deviation. In our BSCS program, 6.87 per cent fell below the cut-off point; 28.07 per cent of the CHEM S students; and 9.99 per cent of the PSSC students.

Dade county regular students (3 years older than the corresponding experimental students) had higher school grades in BSCS and CHEM S but not in physics.

No significant differences in interest could be discerned by science teachers of experimental and matched control students. Evaluations were based on classroom participation, science fair participation, "original thinking", attitude, scientific interest, or unusual observations ("comments"). Self evaluation by experimental and matched control students also revealed no significant differences in

extra-curricular activities, non-assigned scientific or non-scientifc reading. However, the experimental group contained a number of outliers in these three categories.

Data collection proceeded as detailed in the contract. Instruments employed were Rorschach, Bell Personality Inventory and California Occupational Interest Inventory (COII), all administered in group form. Individual Wechsler Intelligence Scale for Children (WISC) and specially constructed structured interviews were given individually. Each participant and paired control was requested to take each test over annually, at preset times. In the present contract, basic COII data were reviewed. WISC scores were tested for correlation with academic achievement, and analysis of structured interview material was initiated, but not completed.

The COII, over two years of study, has revealed significant changes only in personal-social interest with this factor reduced among participants. No evidence was developed that this questionnaire could be used as an aid in selection of students.

The termination of the contract is viewed as an unfortunate event since so much data have been accumulated. Larger numbers of students could have been studied, and duration of observation could have been lengthened, if the contract had been extended. Data already collected could have been analyzed. The WISC scores have proven to be most valuable for selection of students,--those with levels over 120 should perform better and show a lower attrition rate (from all causes) than those with lower WISC scores.

One salutary effect of the termination of the evaluation program is the removal of the restriction of selection of only one of each matched pair of students. Thus, to date, 40 of the top 80 candidates participated, one of each of the 40 top pairs, so that, for example, only 10 of the top 20 students could be in the program, while 10 of the bottom 20 had to participate. Without the necessity for pairing, the 40 most eligible candidates can be selected.

The program has been demonstrated to be feasible. Certain modifications seem justifiable. In addition to selecting the 40 most promising students, the 4 summer involvement may be curtailed to 3 or even 2. Reversal of order of chemistry and physics may be helpful. Mathematics should be emphasized.

Special research studies still are required to judge the value of continuing the program. Another 5 or more years of observation will be necessary.

Introduction:

Hearsay, opinion, pontification, expertise--these have provided the main methods of evaluating programs in the past in health, education, welfare, urban development, politics, finance, and so forth. The initials of these four words constitute the word "hope". More and more, however, is the absolute necessity being recognized, that valid program must be built upon more substantial evaluation than this ephemeral "hope". Adequate evaluation is a process, which starts with a recognized problem. A program is conceived. This conceptualization requires painstaking definition of its own objective: the objective is the desired effect of the conceptualized program on modification of the problem. Having defined the objective, next steps include a precis of the methods of accomplishment, and a parallel evaluation procedure to be executed by comparing program results with preset parameters and criteria of accomplishment.

Some years ago (1957), two youngsters were permitted to spend their summer vacation in the Research Laboratory of the National Children's Cardiac Hospital, Miami, Florida. The seventh year boy spent his time in microbiology; the tenth grade girl, in electrochemistry. The reaction of these teenagers was astonishing. They were intense, capable, anxious sponges, and so impressed us that we felt impelled to offer other youngsters similar chances in the summers in our laboratories. As we became more intimately involved with young science students, we also noted that special opportunities for "exceptional" children (at least in Florida) were restricted almost entirely to the retarded and unstable and excluded the gifted.

Initial programs, supported by the National Science Foundation, did little more than broaden the base of opportunities, but gradually other values began to appear. The current operational project, NSF GE 8475, plus 3 amendments, have the following aims:

1. To motivate and repeatedly reinforce motivation of gifted secondary school students in science;
2. To assure more intensive education in science;
3. To enrich the school science curriculum;
4. To facilitate scientific careers.

This USOE contract was designed to evaluate the operational program "Motivation in Depth for Gifted High School Science Students", supported by the NSF Grant No. GE 8475. The operational project began in 1964, and NSF support terminates October 31, 1968.

Objectives:

The USOE contract had three objectives, and investigates preset hypotheses, as measures of the degree of success of the operational project. These objectives are:

A. To assess the feasibility of presenting standard or varied BSCS, CHEM S, and PSSC programs to gifted students at the junior high school level.

B. To continue to collect data on children participating in the program "Motivation in Depth for Gifted High School Science Students" (funded by NSF GE 8475).

C. To analyze the California Occupational Interest Inventory to appraise its potential value in selection of students likely to choose scientific careers.

Implementation:

A. Feasibility objective.

I. Hypothesis

(1) "Standard achievement scores will indicate successful accomplishment of at least 80 per cent of students selected to participate in the present program."

Method:

Through August 11, 1967, 19 classes have been completed (2 in BSCS in 1964; 2 in BSCS and 2 in CHEM S in 1965; 2 in BSCS, 2 in CHEM S, and 2 in PSSC in 1966; and 2 in BSCS, 2 in CHEM S, 2 in PSSC, and 1 combined section in LO/I in 1967). Regular school grades were issued to all students, according to the system of rating applied by the same teachers during the school year.

Results:

In all, 135 children participated in one or more sections in the experimental group, 4 dropped out after starting a section, one was ill and 1 moved. Grades were not issued in the fourth year, LO/I, section (33 students). Of the remaining 96, 78 received A or B (81.3%), 16 received C (16.7%), and 2, D grades (2%). The 2 children with D grades, and 6 of the 16 with C grades were not recommended for continuation in the total program (8/96 = 8.3%). New classes in BSCS, CHEM S, PSSC and LO/I start June 17, 1968, and run until August 9, 1968.

Details related to each student are part of

the "Annual Progress Report - Fourth Year", submitted to National Science Foundation, October 31, 1967, NSF GE 8475, Amend II, tables 1 through 8.

(2) "Standardized scores in the experimental groups are equal to or higher than those achieved by C_2 group or above national norms."

Method:

Because of many difficulties of obtaining comparable data from a special control group, scores of students in the experimental group were compared with national standards. In the BSCS program, standards have been provided by the BSCS according to sex, with means and standard deviations. CHEM S standards provide only means, while PSSC standards are more vague.

In all comparisons of participant's scores with national standards, all grades have been counted, whether students entered into classroom participation in BSCS, CHEM S or PSSC. (The possibility that late entry might have influenced scores must be recognized.)

Since some teachers gave some tests but not all, while others adopted other minor variations, calculations were made after making appropriate mathematical corrections. No doubt some of these necessary corrections modified the results but these were minimal when cross-checked by other corrections. Furthermore, the consistency of the observations thus far, tend to corroborate the reliability of the data.

In the BSCS calculations, we reasoned that all scores above the mean would include 50 percent of all students, and 1 standard deviation below the mean would encompass approximately 34 percent of the remaining 50 percent, so that any student with a score of less than the mean minus 1 sigma would be in the bottom 16 percent of the class; in other words, those above the lower level would comprise 84 percent of the total class.

In scoring CHEM S students, the national standards of the 1962-1963 and 1963-1964 series were adapted, according to the specific tests given the classes. National standards for all students (no sex difference tabulated) are provided by the CHEM S group.

National average scores for PSSC Series N are provided by the Educational Testing Service in a non-precise fashion. Of a possible 35 points, 32 is the highest level scored nationally; the mean is about 19.5, with 75 percent of those tested having scores of 11.5 or higher; 6 is the lowest record score.

SOUTH DADE AREA (8/67)

NAME	CLASS RANK 1964 BSCS	1965 CHEM S	1966 PSSC	GRADE 1964 BSCS	1965 CHEM S	1966 PSSC	WISC
Teacher**	B	F	K				
Horowitz, E.	1	3	-	A	A	-	133
Horwich, J.	2	7	4	A	A	A	132
Wood, A.	3	14	10	A	B	A	132
Cloogman, H.	4	15	13	A	B	A	128
Ehrlich, C.	5	11	1	A	A	A	122
Wyce, T.	6	17	17	A	C	B	135
Forman, L.	7	2	3	A	A	A	137
Weiss, B.	8	13	15	A-	B	A	146
Layton, C.	9	-	-	A-	-	-	129
Hope, C.	10	6	2	A-	A	A	133
Bell, R.	11	5	-	A-	A	-	134
Gilson, M.	12	16	16	A-	B	A	125
Rosenthal, A.	13	10	18	A-	B	B	124
Burke, J.	14	12	11	B+	B	A	117
Hollins, G.	15	-	-	B+	-	-	117
Banyai, J.	16	9	-	B	B	-	131
Williams, G.	17	18	12	B	C	A	101
Rosenkrantz, C.	18	1	14	B-	A	A	131
Arnold, P.	19	-	-	B-	-	-	115
Zilliner, J.	21	19	19	B-	C	Inc.	104
Weinberger, D.	-	8	-	-	A	-	135
Farkas, C.	-	4	7	-	A	A	-
Kazer, R.*	1*	-*	5	A*	-*	A	141
Perez, J.	-	-	6	-	-	A	125
Wang, G.	-	-	8	-	-	A	134
Balsam, A.	-	-	9	-	-	A	128

* Special student
** Teachers:- A, B, C = BSCS
D, E, F, G. H = CHEM S
I, J. K. L = PSSC

(9/67)

TABLE 1 - Grades and Class Rank of South Dade Students Selected for Participation 1964 (From NSF report)

NORTH DADE AREA (8/67)

NAME	CLASS RANK			GRADE			WISC
	1964 BSCS	1965 CHEM S	1966 PSSC	1964 BSCS	1965 CHEM S	1966 PSSC	
Teacher	A	D	I				
Jarvinen, G.	1	1	1	A	A	A	137
Mozer, T.	2	2	6	A	A	B	125
Dugoni, D.	3	5	11	A	A	B	131
Wilson, A.	5	4	-	B	A	-	138
Meadow, J.	6	-	-	B	-	-	137
Rose, R.	7	6	3	B	B	A	141
Chan, E.	8	15	12	B	B	B	128
Walden, P.	9	20	-	B	C	-	123
Clavier, D.	10	18	9	B	B	B	109
Anderson, B.	11	-	-	B	-	-	138
Canosa, F.	12	19	18	B	B	C	124
Schwartz, K.	13	13	8	B	B	B	113
Kirkpatrick,R.*	14	16	-	B	B	-	137
Leopold, S.	15	-	-	C	-	-	131
Otazo, J.	16	-	-	C	-	-	123
Pitts, H.	17	-	-	C	-	-	119
Esquivel, J.	18	-	-	C	-	-	118
Foltz, W.	19	-	-	D	-	-	128
Beloff, D.	-	8	4	-	B	A	136
Benedict, J.	-	10	14	-	B	B	142
Berdeaux, D.	-	11/12	7	-	B	B	128
Hamilton, L.	-	7	16	-	B	C	127
Mendez, J.	-	14	15	-	B	B	136
Ramirez, E.	-	17	13	-	B	B	104
Rotger, T.	-	9	17	-	B	C	136
Thompson, D.	-	11/12	-	-	B	-	120
Wright, T.	-	3	2	-	A	A	131
Ellis, A.	-	-	5	-	-	B	128
Raben, K.	-	-	10	-	-	B	120
Alford, L.**	20	21	19	B-	C	C	119
Strong, V.	D^1	-	-	D^1	-	-	125

*PSSC during academic year - 1966-67
** South Dade Area - BSCS 1964
D^1 Dropped after 2 weeks

(9/67)

TABLE 2 - Grades and Class Rank of North Dade Students Selected for Participation 1964 (From NSF report)

SOUTH DADE AREA (8/67)

NAME	CLASS RANK			GRADE			WISC
	1965 BSCS	1966 CHEM S	1967 PSSC	1965 BSCS	1966 CHEM S	1967 PSSC	
Teacher	B	G	L				
Russell, W.	2	1	1	A	A+	A	129
Poulos, G.	3	5	2	A	A	A	142
Poag, M.	4	12	-	A	B	-	138
Davis, P.	5	3	3	A	A	A	127
Hamilton, R.	6	14	-	A	B	-	125
Cheverette, M.	7	D[1]	-	A	D[1]	-	120
Shapiro, K.	8	-	-	B	-	-	140
Jacobs, R.	9	16	-	B	C+	-	138
Thomas, D.	10	15	-	B	C+	-	107
Nix, S.	11	9 1/2	7	B	B+	B	121
Reiff, P.	12	-	-	B	-	-	133
Morgan, M.	13	8	5	B	A-	A	121
Rosenblatt,A.	14	10	8	B	B+	B	123
Martinez, M.	15	D[2]	-	B	D[2]	-	137
Blanco, L.	16	9	11	B	A-	C	125
Carr, L.	17	6	D[4]	B	A	D[4]	135
Crapp, T.	18	-	-	B	-	-	109
Linett, L.	19	11	9	B	B	C	110
McDonald, Wm.	20	17	-	C	C-	-	113
Evans, B.	21	-	-	C	-	-	132
Warner, Wm.	22	13	-	C	B-	-	128
Kaplan, K.	-	2	-	-	A+	-	135
Brenner, M.	-	4	6	-	A	B	128
Paterson, P.	-	7	-	-	A-	-	132
Richman, J.	-	D[3]	-	-	D[3]	-	128
Collins, M.	-	-	10	-	-	C	128
Shipp, T.*	-	-	12	-	-	C	117
Steinhardt,P.	-	-	4	-	-	A	127

D[1] Dropped out voluntarily
D[2] Dropped out because of financial reasons
D[3] Dropped by request, unable to perform adequately
D[4] Dropped due to illness, making up deficiency during academic year
* Not recommended (9/67)

TABLE 3 - Grades and Class Rank of South Dade Students Selected for Participation 1965 (From NSF report)

NORTH DADE AREA (8/67)

NAME	CLASS RANK			GRADE			WISC
	1965 BSCS	1966 CHEM S	1967 PSSC	1965 BSCS	1966 CHEM S	1967 PSSC	
Teacher	A	E	J				
Nussbaum, J.	1	8	9	A	B	B	120
Sawyer, P.	2	5	7	A	A	B	123
Driver, K.	3	3	5	A	A	B	145
Glick, J.	4	9	-	A	B	-	129
Secord, L.	5	13	11	A	C	C	124
Frick, N.	6	16	-	B	C	-	128
McLeod, C.	7	11	12	B	B	C	109
Sheeder, E.	8	7	3	B	B	B	127
Biddle, G.	9	12	-	B	C	-	130
Cochran, F.	10	14	-	B	C	-	114
Reskin, D.	11	D[1]	-	B	D[1]	-	141
Hill, J.	12	-	-	B	-	-	120
Raben, P.	13	19	-	B	D	-	126
Helgren, F.	14	10	10	B	B	B	126
Reilly, P.	15	21	-	B	C	-	137
Walker, D.	16	17	8	B	C	B	120
Loffredo, S.	17	15	4	B	C	B	136
Dean, C.	18	20	-	B	D	-	131
Zwerin, P.	19	2	2	B	A	A	124
Rowe, E.	20	18	-	B	C	-	113
Berke, P.	-	4	1	-	A	A	144
Lottenberg,R.*	4(64)	1	-	B+(64)	A	-	125
Kalil, R.	-	6	-	-	A	-	131
Mize, J.	-	-	6	-	-	B	130
Hodges, D.	-	-	13	-	-	C	126

D[1] Dropped out due to illness, will rejoin in 1967
* Dropped out in 1965, father's illness; rejoined in 1966

(9/67)

TABLE 4 - Grades and Class Rank of North Dade Students Selected for Participation 1965 (From NSF report)

SOUTH DADE AREA (8/67)

NAME	RANK 1966 BSCS	RANK 1967 CHEM S	GRADE 1966 BSCS	GRADE 1967 CHEM S	WISC
Teacher	B	H			
Myers, C.	1	1	A	A	130
McElwain, A.	2	9	A	B	124
Ostlund, S.	3	2	A	A	126
Berry, N.	4	4	A	A	120
Alvarez, O.	5	3	A	A	132
Navarro, O.	6	14	A	B	123
Toggweiler, R.	7	5	A	A	127
Rohling, C.	8	16	B	D	134
Rayfield, M.	9	10	B	B	135
Gardner, B.	10	12	B	B	147
Conover, D.	11	-	B	-	125
Johnson, S.	12	11	B	B	127
Hertz, B.	13	8	B	B	134
Locke, P.	14	-	B	-	128
Fink, S.	15	15	B	C	118
Spradley, M.	16	-	B	-	125
Kambour, M.	17	-	C	-	128
Collier, M.**	18	17	C	D	114
Counts, B.	19	-	C	-	117
Strazulla, T.	20	-	C	-	120
Colden, M.	21	-	F	-	115
Boder, B.*	14	13	B	B	126
Baskin, M.	-	7	-	B	130
Pumariega, A.	-	6	-	B	134

* Transferred from other section
** Not recommended

(9/67)

TABLE 5 - Grades and Class Rank of South Dade Students Selected for Participation 1966 (From NSF report)

NORTH DADE AREA (8/67)

NAME	RANK 1966 BSCS	RANK 1967 CHEM S	GRADE 1966 BSCS	GRADE 1967 CHEM S	WISC
Teacher	A	E			
Weiselberg, M.	1	-	A	-	125
Vitale, G.	2	3	A	A	128
Slaney, E.	3	15	A	B	137
Olinger, D.	4	8	A	B	129
Kingstad, N.	5	9	A	B	129
Celio, J.	6	14	B	B	131
Schaumberg, W.	7	-	B	-	134
Malone, R.	8	7	B	A	134
Osborne, C.	9	D^1	B	D^1	141
Reeves, J.	10	17	B	C	128
Sedrish, J.	11	D^1	B	D^1	152
Hooten, R.	12	-	B	-	116
Hines, M.	13	11	B	B	127
Boder, B.*	14	-	B	-	126
Neale, P.	15	5	B	A	142
Kahn, L.	16	6	B	A	143
Lochner, C.	17	2	B	A	137
Wilson, G.	18	16	B	C	112
Lee, R.	19	-	B	-	119
Johnson, C.	20	-	C	-	117
Myers, D.	21	-	C	-	112
Saphire, I.	-	1	-	A	128
Bernstrom, G.	-	4	-	A	122
Pepper, J.	-	10	-	B	134
Fay, E.	-	12	-	B	136
Gauss, C.	-	13	-	B	132
Jollivette, C.**	-	18	-	C	109

D^1 Lost interest
* Transferred to other section
** Not recommended

(9/67)

TABLE 6 - Grades and Class Rank of North Dade Students Selected for Participation 1966 (From NSF report)

SOUTH DADE AREA (8/67)

NAME	RANK 1967 BSCS	GRADE 1967 BSCS	WISC
Teacher	C		
Mannheimer, T.	1	A	122
Mondschein, B.	2	A	134
Beales, M.	3	A	137
Cosio, R.	4	A	127
Mann, D.	5	A	134
Reaves, J.	6	B	127
Shuch, T.	7	B	144
Manley, J.	8	B	154
Geller, J.	9	B	134
Butler, J.	10	B	138
Gancarz, D.	11	B	133
Bongiovanni, Wm.	12	B	114
Norris, G.	13	B	125
Clark, J.	14	B	134
Rodriguez, I.	15	B	123
Sierra, M.	16	B	120
Payne, B.	17	C	114
Homer, G.*	18	C	115
Evans, M.*	19	C	122

* Not recommended

(9/67)

TABLE 7 - Grades and Class Rank of South Dade Students Selected for Participation 1967 (From NSF report)

NORTH DADE AREA (8/67)

NAME	RANK 1967 BSCS	GRADE 1967 BSCS	WISC
Teacher	A		
Cohen, I.	1	A	137
Rosenberg, S.	2	A	115
Renderer, J.	3	A	123
Perry, R.	4	A	127
Ackerman, E.	5	A	110
Dreyfus, A.	6	A	128
Hoffman, S.	7	A	125
Sutton, J.	8	A	125
Scavella, M.	9	B	124
Garris, D.	10	B	112
Kenna, R.	11	B	111
Field, W.	12	B	136
Rubin, B.	13	B	130
Pruett, K.	14	B	133
Johnson, P.	15	B	123
Holman, D.*	16	C	115
Wilcox, L.*	17	C	111

*Not recommended

(9/67)

TABLE 8 - Grades and Class Rank of North Dade Students Selected for Participation, 1967 (From NSF report)

Results:

Findings in the BSCS program are indicated in table 9 and 10.

In all, 11 of 160 students (6.87 per cent) scored in the low 16 percent area of students tested nationally.

Among the 114 chemistry participants, 32 (28.07 per cent) fell in the category anticipated as containing 16 per cent of nationally tested students. Results are detailed in tables 11 and 12.

Tables 13 and 14 show the results of the PSSC data. Four of the 44 participating students (9.99 per cent) fell below the national average minus one standard deviation.

Data from all three curricula, BSCS, CHEM S, and PSSC are summarized in table 15.

II. Hypothesis

"School grades in science and non science academic subjects will be higher in the experimental than in the control group (after the seventh grade). (Future evaluation may reveal that this gap increases with each succeeding year of participation in the program)."

Method:

Complete academic grades were recorded for each of the experimental participants. The same data were tabulated for the matched pair controls. Based on academic ratings, sex, approximate socioeconomic status and ethnic background, BSCS participants were matched with a second set of controls, who completed BSCS in the 10th grade; CHEM S participants with those who completed CHEM S in 11th grade; and PSSC participants with those who completed PSSC in 12th grade.

Recording of individual scores was according to the teachers grades: A =4; B =3; C=2; D=1; E or F =0. Because of the shortened duration of this grant (compared with the time requested), only sufficient meaningful data are available on C_2 students to warrant comparison of BSCS, CHEM S, and PSSC scores.

Results:

(1) The BSCS data included academic grades

Scores of Students in BSCS, in Program "Motivation in Depth for Gifted High School Science Students," Compared with National Scores

NORTH

Year	1964	1965	1966	1967
Nat'l. Av., male	64.55	64.55	64.55	146.83
" $\mu \pm 1\sigma$, male	14.69	14.69	14.69	7.22
" Av., female	62.85	62.85	62.85	143.29
" $\mu \pm 1\sigma$, female	14.85	14.85	14.85	7.19
Class Av., male	62.85	57.64	59.82	160.8
N/- σ*, male	13/1	14/2	11/0	10/0
Class Av., female	64.33	52.50	54.10	151.57
N/- σ*, female	6/0	6/2	10/2	7/2
Teacher	A	A	A	A

*N=Number of students in each section; $-\sigma$= Number of students who failed to attain a score of $\mu-1\sigma$ on national tests.

TABLE 9

Scores of Students in BSCS, in Program "Motivation in Depth for Gifted High School Science Students", Compared with National Scores

SOUTH

Year	1964	1965	1966	1967
Nat'l. Av., male	29.50	29.50	29.50	29.50
" $\mu \pm 1\sigma$, male	7.23	7.23	7.23	7.23
" Av., female	28.74	28.74	28.74	28.74
" $\mu \pm 1\sigma$, female	7.18	7.18	7.18	7.18
Class Av., male	35.0	32.26	32.43	34.28
N/-σ*, male	14/0	16/0	15/1	13/0
Class Av., female	30.34	30.13	29.93	31.13
N/-σ*, female	7/0	6/0	6/0	6/1
Teacher	B	B	B	C

*N=Number of students in each section; -σ= Number of students who failed to attain a score of μ-1σ on national tests.

TABLE 10

Scores of Students in CHEM S, in Program "Motivation in Depth for Gifted High School Science Students", Compared with National Scores

NORTH

Year	1965	1966	1967
Nat'l. Av.	139.6	(114)	139.6
" $\mu \pm 1\sigma$	6.76	(31.7)	6.76
Class Av., male	138.92	114**	178.2
N/-σ*, male	13/4	21/0**	10/0
Class Av., female	129.33	-	142.25
N/-σ* , female	8/3	-	8/3
Teacher	D	E	E

*N=Number of students in each section; -σ= Number of students who failed to attain a score of μ-1σ on national tests.

**Males and females combined

TABLE 11

Scores of Students in CHEM S, in Program "Motivation in Depth for Gifted High School Science Students", Compared with National Scores

	SOUTH		
Year	1965	1966	1967
Nat'l. Av.	123.5	139.6	139.6
" $\mu \pm 1\sigma$	6.93	6.76	6.76
Class Av., male	120.5	153.99	154.53
N/-σ*, male	14/6	14/5	13/5
Class Av., female	108.8	138.75	146.25
N/-σ*, female	5/3	4/2	4/1
Teacher	F	G	H

*N=Number of students in each section; -σ= Number of students who failed to attain a score of μ-1σ on national tests.

TABLE 12

Scores on Students in PSSC, in Program "Motivation in Depth for Gifted High School Science Students", Compared with National Scores

	NORTH	
Year	1966	1967
Nat'l. Av.	19	17.1
" $\mu \pm 1\sigma$	-	6.7
Teacher Av.	14	-
" $\mu \pm 1\sigma$	-	-
Class Av.	15.82	19.60
" $\mu \pm 1\sigma$	3.71	2.56
Av., male	17.14	20.09
N/-σ*, male	13/0	9/1
Av., female	12.93	18.50
N/-σ*, female	6/1	4/1
Teacher	I	J

*N=Number of students in each section; -σ= Number of students who failed to attain a score of μ-1σ on national tests.

TABLE 13

Scores on Students in PSSC, in Program "Motivation in Depth for Gifted High School Science Students," compared with National Scores

	SOUTH	
Year	1966	1967
Nat'l. Av.	NOT DONE	17.1**
" $\mu \pm 1\sigma$		6.7
Av., male		20.87
N/-σ*, male		7/1
Av., female		14.98
N/-σ*, female		5/0
Class Av.		18.42
" $\mu \pm 1\sigma$		3.90
Av., male		20.87
N/-σ*, male		7/0
Av., female		14.98
N/-σ*, female		5/3
Teacher	K	L

*N=Number of students in each section; -σ= Number of students who failed to attain a score of μ-1σ on national tests.

**9 tests only

TABLE 14

Number and Percent of Participants who Failed to attain a Score of $\mu-1\sigma$ on National Testing, by year, teacher and course.

Year		1964		1965		1966		1967		Total	
Students*		N	-σ	N	-σ	N	-σ	N	-σ	N	-σ
						NORTH					
Course	Teacher										
BSCS	A	19	1	20	4	21	2	17	2	77	9
CHEM S	D	-	-	21	7	-	-	-	-	-	-
	E	-	-	-	-	21	0	18	3	60	10
PSSC	I	-	-	-	-	19	1	-	-	-	-
	J	-	-	-	-	-	-	13	2	32	3
								Total North		169	22
										(13.0%)	
						SOUTH					
BSCS	B	21	0	22	0	21	1	-	-	-	-
	C	-	-	-	-	-	-	19	1	83	2
CHEM S	F	-	-	19	9	-	-	-	-	-	-
	G	-	-	-	-	18	7	-	-	-	-
	H	-	-	-	-	-	-	17	6	54	22
PSSC	K	-	-	-	-	-	ND	12	1	12	1
	L	-	-	-	-	-	-	-	-	-	-
								Total South		149	25
										(16.8%)	
								Grand Total		318	47
										(14.8%)	

Total BSCS	160N:11-σ	= 6.87%
CHEM S	114/32	=28.07%
PSSC	44/4	= 9.99%

*N = Number of students in each section; -σ = Number of students who failed to attain a score of $\mu-1\sigma$ on national tests.

TABLE 15

for 124 participants, and 66 controls who took BSCS in Dade County Senior High Schools, at the tenth grade level. The experimental group had a mean of 3.218, with 0.657 standard deviation; the controls had 3.485 and 0.614 respectively. This difference is statistically significant with a p value less than 0.007.

(2) The mean of 112 CHEM S participants was 3.116 with standard deviation of 0.825; the 47 eleventh grade controls had 3.489 and 0.655. This difference also was significant ($p < 0.007$).

(3) The 60 participants in the PSSC program yielded a mean of 3.250 with 0.751 standard deviation; 26 twelfth grade controls had 2.962 and 0.824 respectively. The difference is not statistically significant ($p < 0.116$).

III. Hypothesis

"Students in the experimental group show increased interest in science and non-science academic subjects, when compared with controls (C_1) matched pairs."

Method:

Data on interest of E and C_1 students in science and non-science subjects are available through four sources.

(1) Psychologists' reports on structured interviews. Results will be detailed below, under "Analysis Objective".

(2) Psychologists' reports on the COII. Results will be detailed below, under "Analysis Objective".

(3) Teachers' questionnaires (Exhibit 1a and 1b). These were distributed to current teachers of E and C_1 students.

Results:

Information is available on 167 children, 114 in the experimental group and 53 controls. Table 16 shows that the teachers of 81 children in the former group (71 per cent) were aware of the students' participation (95 replies), while, in the later group, only 18 (34 per cent) were known. Eighty-eight of the 95 positive replies in the "classroom" group indicated that more than half of the "awareness" resulted from the students' notification of the teacher; less than half the notifications were through school channels.

MOTIVATION IN DEPTH FOR GIFTED
HIGH SCHOOL SCIENCE STUDENTS

University of Miami Dade County Public Schools

TEACHER EVALUATION FORM OF SCIENCE INTEREST

_____in your_____class, is in our special program studying methods to motivate students into science careers. Did you know he/she has been in this program? YES____ NO____

1. If you did know, how did you find out?
   a. Student told me himself____
   b. Other students told me____
   c. School principal/guidance/science supervisor/other teacher
   d. Child's parents____
   e. Through my direct connection with the program____
   f. Other___Specify_____

2. In regard to his class participation, I would rate him
   a. Among the top 3 students____
   b. Above average, but lower than the top 3____
   c. Average____
   d. Below average, but not in the bottom 3____
   e. Among the bottom 3____

3. In Science Fair Participation

   a. Did outstanding work____
   b. Did good work____
   c. Did average work____
   d. Did less work than the average____
   e. Did very poor work____
   f. Did not participate in the Science Fair____

4. My estimate of his original thinking in science
   a. Insight among the top 3 students____
   b. Some logical questioning____
   c. Average____
   d. Little logical questioning____
   e. Insight low, among bottom 3____

Exhibit 1a

5. His attitude toward class presentations
   a. Among the top 3 students___
   b. Above average____
   c. Average____
   d. Below average____
   e. Among bottom 3____

6. Any specific comments? Related to career discussion--plans for school or after-school work or play related to science--any extracurricular in-school discussions of scientific books, journals, home laboratory, etc.--anything else worthy of note_____

_____

_____

_____

7. Your estimate of the overall standing of the student as related to scientific interest (not necessarily his class grade)
   a. Among top 3____
   b. Above average_____
   c. Average_____
   d. Below average_____
   e. Bottom 3_____

8. How many students in the average class of 30 will usually receive A as a grade?_____

9. How many are in the science class with the above mentioned student?_____ How many usually receive A as a grade in this particular class?_____

Date_____ Signature_____

School_____

Exhibit 1b

Teacher awareness of student participation
in present program
(Responses to Question One of Exhibit 1a)

RESPONSES	a	b	c	d	e	f	TOTAL Yes	No
Experimental	42	3	36	2	6	6	95	33
Control	4	2	7	0	4	1	18	35

TABLE 16

Analyses of the teachers' estimates of class participation were based on question 2 of the Exhibit 1 questionnaire. The scores were as follows: 5=a; 4=b; 3=c; 2=d; 1=e. The average rating of the classroom participants was 4.49, while the control was 4.45. In this study, both groups participated equally in classroom activities.

Question 3, Science Fair Participation, was scored in the same fashion. In addition, 0 was assigned to the f. response. The classroom group average was 1.23; nonclassroom 2.09. The scores were also calculated for only those who were involved in the Fair activities. These corresponding averages were 3.68 and 3.83. Why the classroom participants were less prone to enter the Science Fair than the control group is not clear.

Teacher evaluation of "original thinking" (question 4) was scored in the same manner as question 2. Average for participants was 4.44; controls, 4.36.

Attitude toward class presentations (question 5), scored similarly, and yielded similar 4.44 and 4.36 averages.

The open-ended question 6, "comments", presented problems in evaluation. Though admittedly arbitrary, one point was scored for each positive comment. Participants averaged 2.27 and the controls 2.44. When those forms on which no comments were made were excluded, the averages of both groups of students were identical, 3.20.

"Scientific interest" as determined by question 7, yielded average scores of 4.38 for the control and 4.42 for the experimental groups.

Questions 8 and 9 were not calculated because the number of records submitted was small and indicated considerable confusion in interpretation among the respondents.

Questions 2 through 7, as reflectors of interest of students in science show no significant difference in the two groups of children.

(4) Self-administered questionnaires (Exhibit 2) were distributed to each of the E and C_1 students. Extracurricular activities and non-assigned scientific and non-scientific reading were the criteria employed.

MOTIVATION IN DEPTH QUESTIONNAIRE USOE 1/67

Milton S. Saslaw, M.D.
1390 N.W. 14 Ave., Rm 201, Miami, Fla. 33125

In connection with your participation as a classroom/non-classroom member of our program "Motivation in Depth", would you please complete the form below and return it in the enclosed envelope by Jan. 13, 1967. Please be prompt. This is IMPORTANT.

I. I engage in the following extracurricular activities:-

1. In school:_____
2. In church:_____
3. In Outside Clubs:_____
4. In Civic Work:_____
5. In Scouts:_____
6. In Home:_____
7. In Athletics:_____
8. At Work:_____
9. In Hospital Work:_____
10. Other (specify):_____

_____

II. What reading have you done since January 1, 1966 not required as school reading:-

A. Non-scientific
   1. Books_____

      _____
   2. Journals or magazines_____

      _____

B. Scientific
   1. Books_____

      _____
   2. Journals or magazines (Scientific American, Science Digest, etc.)

      _____

      _____

Student's Name_____ Date_____
(Please print)

Address_____

Exhibit 2

Results:

Data have been collected from 112 E and 56 C_1 students. Results of these self-administered questionnnaires are summarized in table 17.

No significant differences between experimental and control groups can be seen in any of the three categories. Total scores were calculated, and here again, no statistically significant differences of the means appeared ($t_{(05)}$ (df inf.) = 1.106; CL - 1.65; M_E = 26.7, M_C = 22.5, t = 1.106; p =.28)

In all three areas of study, however, the experimental group had more outliers, both in actual numbers and in percentages, than the control group.

B. Data collection objective.

All desired tests were carried out, in accordance with the operational program, as stated in the contract proposal. Detail of the interviews, tests and inventories administered are shown in table 18.

C. Analysis objective.

I. Hypothesis

"The California Occupational Interest Inventory (COII) reflects scientific interest where such interest exists. Serial studies indicate changes in interest: more of the experimental than of the control students will manifest an increase in scientific interest. The experimental student also will be more likely to indicate greater interest in a specific discipline of science than C_1."

Method:

California Occupational Interest Inventories on all 1964, 1965, and 1966 E and C_1 students were scored and tabulated for computer punch-carding and analysis. These materials were processed by Dr. Dean Clyde, Biometric Laboratory, University of Miami.

Preliminary computation of changes in differences (analysis of covariance) between 14 matched pairs who were tested in 1964 and 1966, failed to show any significant findings in any of the 10 areas of the test. In the factor of personal-social interest the change approached

Activities and Reading reported by Students in present Program

No. Items Reported		0-4	5-9	10-14	15-19	20-24	25-29	30+	Total
Extracurricular Activities:									
Experimental	No.	37	47	23	4	1	-	-	112
	%	33	42	21	4	1	-	-	-
	Cum. %	33	75	96	100	101	-	-	-
Control	No.	16	33	7	-	-	-	-	56
	%	29	59	13	-	-	-	-	-
	Cum. %	29	88	101	-	-	-	-	-
Non-Scientific Reading:									
Experimental	No.	10	43	37	8	6	2	6	112
	%	9	39	33	7	5	2	5	-
	Cum. %	9	48	81	88	93	95	100	-
Control	No.	12	21	14	3	1	2	3	56
	%	21	38	25	5	2	4	5	-
	Cum. %	21	59	84	89	91	95	100	-
Scientific Reading:									
Experimental	No.	54	45	10	2	1	-	-	112
	%	48	40	9	2	1	-	-	-
	Cum. %	48	88	97	99	100	-	-	-
Control	No.	38	17	1	-	-	-	-	56
	%	68	30	2	-	-	-	-	-
	Cum. %	68	98	100	-	-	-	-	-

TABLE 17

Interviews, tests, and inventories administered during operation of "Motivation in Depth for Gifted High School Science Students"

TEST*		WISC	SI	COII	Ror	Bell	SRA
1964	Spring	X			X	X	
	Fall		X			X	X
1965	Spring	X		X	X	X	
	Fall		(NO MONEY AVAILABLE)				
1966	Spring	X		X	X	X	
	Fall		X	X		X	
1967	Spring	X		X	X	X	
	Fall		X	X	X	X	
1968	Spring	X		X	X	X	
	Fall		(NO MONEY AVAILABLE)				

* WISC = W.I.S.C. (Individual)
SI = Structured Interview (Individual)
COII = California Occupational Interest Inventory (Group)
Ror = Rorschach (Group)
Bell = Bell Personality Inventory (Group)
SRA = Science Research Associates Junior Inventory (Group)

TABLE 18

significance (p = .086). Since the matched pairs added little to the statistical analysis, and the small N (14) militated against any significant findings, two further steps were executed:

i. Recalculation of the same data, comparing the total experimental group with the total C_1 group (obviating matched pairs and increasing N).

ii. Because of anticipated benefits for the experimental group in interest in science, manipulative and verbal factors, each of these was paired with personal-social interest to determine whether any combination of factors might have significance in selection of students and/or in evaluation of the program.

Recalculation of the COII data was carried out in order to compare the total experimental and control groups for covariance of personal-social, verbal, manipulative and science interests from 1964 to 1966. This technique changed N (14 pairs) to N (33 experimental + 18 controls).

Results:

Analysis of these data indicate that:

(1) The personal-social interest factor demonstrated a statistically significant covariant difference (p = .046);

(2) Simultaneous inclusion of the verbal, manipulative and scientific interest factors, increased the difference (p = .034);

(3) The personal-social interest factor showed a negative correlation with classroom participation in the program.

Completion of data acquisition on the participants who entered the program in 1965, permitted repetition of these calculations with an experimental group of 40 and 31 controls. Univariate F tests showed interests, from which p values less than 0.081, 0.163, 0.019, and 0.749 were calculated. Only the verbal factor is significant statistically, while personal-social and science interest factors showed trends only.

The calculation of overall significance, using the Wilks Lambda Criterion and canonical correlations, yielded a p value of less than 0.088.

Covariate analysis of the 5 factors, personal-social, science, verbal, manipulative, and level of

interest failed to provide any additional information. Repeat of this analysis over a two year span produced an overall p value of less than 0.038 for the 5 factors; univariate F analysis produced only one p value of significance (0.049) for the personal-social factor only.

II. Observed Concepts

1. WISC scores reflect ability of students to cope with the program, to the extent that a level of 120 or below is associated with (a) lower grades and (b) more attrition than a level above 120.

a. Lower grades

Method:

WISC scores were correlated with final letter grades recorded by each teacher. In these calculations only those students were included who began their classroom participation in BSCS; those who entered in CHEM S or PSSC were not counted. This exclusion was based on the concept that late entry might actually place a handicap on such students, and inclusion of different correlational levels was not justified.

Results:

Those students whose individual WISC scores (administered by the psychologists in the program) were 120 or under received very few A grades, and many more C or lower grades from their instructors (table 19).

b. Consideration of attrition

Method:

Loss of any child from the classroom section of the program was included. Cause was classified as: (i) moved, to account for those whose absence from the area precluded any further participation; (ii) voluntary dropouts; (iii) failure, in which category were placed those who were not recommended for continuation. The "voluntary dropouts" were those who lost interest, who "had" to go away for the summer, who had to earn money, who were ill but made no effort to rejoin the program, who had conflicts in school or summer programs, or who were encouraged to drop out of the program by parents, sex or guidance counsellors (table 20).

Correlation of School Grades with WISC Scores (Only Students who began participation in BSCS in Classes)

School Grades	WISC SCORES		Total
	Over 120	120 or Less	
A	97	4	101
B	111	27	138
C or less	25	26	51
TOTAL	233	57	290

df = 2

$\chi^2 = 38.20$

$p < 0.001$ ($\chi^2 = 13.815$; $p = 0.001$)

TABLE 19

Attrition of Program Including all Classroom Participating Students, According to Year of Entry into Program

Starting Year	WISC SCORES		Total
	Over 120	120 or Less	
1964	45	10	55
1965	45	8	53
1966	41	10	51
1967	27	9	36
Total	158	37	195

Attrition

Moved	6	1	7
Voluntary Dropouts	35	19	54
Failures	7	12	19
Total	48	32	80

TABLE 20

Chi square determinations were performed.

Results:

Of 195 participating students, 80 were lost to the classroom portion of the program (41 per cent). Major causes for losses are indicated in table 21. Chi square calculations indicated a statistically significant difference in total losses when a WISC score of over 120 was used as a cut-off point. When failure alone (including non-recommendations for continuation) was considered, table 22, the cut-off point of over 120 WISC score also indicated a statistically significant difference ($p < 0.001$).

2. Unusual educational and/or socio-cultural background militate against ability to cope with the program.

Method:

In the selection of students, since the inception of the program, a distinct attitude of liberalism was evident, in regard to individuals with other than average background. In recognition of probable past difference in educational or cultural opportunities, guide lines were relaxed. For example, SCAT and other school scores markedly lower than among average background students, were acceptable for inclusion of "different background" students. School grades were accepted at lower levels, though academic averages of C or lower were excluded. Oral interviews were carried out with no type of segregation, but fewer, less precise, and less impressive responses were accepted. Psychological testing also was more permissive, though there was concern frequently as to possible emotional damage to the child who might not succeed in the program. Often the program personnel arranged for extra help for these students (extra reading help, extra help in physics, etc.) to assist these children in completion of the program. Tables were constructed, showing degree of success in continuing in the program, along with WISC scores. Major groups were considered: Negroes and Parochial school attendees in contrast to public school white students. Although a third category, Cuban refugees, merits review, no special study was done, because the small numbers of individuals in the project scarcely reflect the current turmoil and turbulence among their people.

Attrition of Program Including all Classrooms Participating Students, According to WISC Scores

Outcome	WISC Scores		Total
	Over 120	120 & Under	
Lost to Program	48	32	80
Remaining in Program	110	5	115
Total	158	37	195

df = 1

$\chi^2 = 38.896$

$p < 0.001$

($\chi^2 = 10.827$; $p = 0.001$)

TABLE 21

Correlation of Failure with WISC Score
(All Students who Participated in Classroom Sessions)

Failure & Drop	WISC SCORES		Total
	Over 120	120 or Less	
Yes	7	12	19
No	151	25	176
Total	158	37	195

df = 1

$\chi^2 = 26.8$

$p < .001$

($\chi^2 = 10.827$; $p = 0.001$)

TABLE 22

Results:

As may be noted in table 23, of the 14 special category students removed from participation by program officials, WISC scores were below 120 in eleven. Furthermore, the attrition rate among the students with non-average backgrounds ranged from 39 to 100 per cent, compared with 37 per cent among white public school students. This difference, table 24, is suggestive but not statistically significant ($p = 0.069$).

The significance of the WISC score is further indicated by the loss for all reasons of 32 of 37 participants with 120 or lower levels (86.5 per cent), while the total loss among those 158 participants who had scores over 120 was 48 (30.4 per cent).

Comments and Conclusions:

The program "Motivation in Depth for Gifted High School Science Students" is feasible. This conclusion is based on the observations (1) that 91.7 per cent of all class performances were considered satisfactory in meeting school requirements; (2) that participating students in BSCS and PSSC attained scores on national tests more favorable than national controls, while students in CHEM S were less favorable; and (3) that the participants performed satisfactorily when compared with student controls who took the same BSCS, CHEM S and PSSC curricula three years later (tenth, eleventh, and twelfth grades), during full academic years. The experimental group scored higher in physics, and lower in biology and chemistry, but still acceptably.

The feasibility of the program, however, is not of itself justification for its continuance. Intensive in depth evaluation must provide the data for such justification. Hearsay, opinion, pontification and expertise are inadequate. Unfortunately, the present evaluation project was so limited that it offers no more than rudimentary findings on which to make future recommendations. The curtailment of the scope and duration of the original request created a strong conflict among the investigating staff because of the realization that the desired goal and most objectives could not be attained. Final decision to accept this abortive approach followed the conclusions that even an abbreviated evaluation might be more productive than no evaluation, and that the productivity of the abbreviated evaluation might lead to extension of support to continue the project. Fortunately, the former conclusion materialized; unfortunately, the latter did not.

Discernible evaluative findings are recognizable in the school grades and in the national test averages attained;

Attrition from Classroom Participation Section of Program: Parochial and Negro Students, WISC Scores, and Reasons for Loss

Category	Entered	Remaining (by WISC Score)	Dropped (by WISC Score and Reason)	Per Cent Loss
Grand Total	195	115	80	41
Public School White Only	146	92	54	37
Public School Negro	23	8*	1 M(127) 6 V** 8 F***	
Total			15	65
Parochial				
Hebrew	1	0	1 M(133)	100
Protestant	2	1(131)	1 M(127)	50
Catholic	23	14°	3 V°° 6 F°°°	
Total			9	39
Total Parochial and Negro	49	23	26	53

M = Moved; V = Voluntary dropout; F = Dropped for inability

*(124,120,119,112,109,104,103,101)
**(117,114,114,113,112,109)
***(122,117,117,115,115,114,111,109)
°(142,142,137,136,135,135,133,131,127,124,123,117,110,104)
°°(137,136,128)
°°°(137,123,118,115,113,107)

TABLE 23

Attrition from Classroom Participation Section of Program:
Public School White Students Only Compared to All Others

School Group	Losses	Remaining	Total
Public, white only	54	92	146
All others	26	23	49
Total	80	115	195

df = 1

$\chi^2 = 3.52$; $0.10 > p > 0.05$ ($p=0.06943$)

($\chi^2 = 2.71$; $p = .1$: $\chi^2 = 3.84$; $p = .05$)

TABLE 24

in the favorable achievement in BSCS and PSSC, but less favorable in CHEM S; in the failure of proof of direct stimulation of scientific interest (motivation?); in the communication weakness in relation to school teacher awareness; in the potential value of WISC testing; in the findings of the structured interviews; in the collection of data on group Rorschach and Bell Personality Inventory tests; in available longitudinal psychological test scores (not analyzed); in the differences in potential in negotiating the curriculum, of white public school students compared with other students with different ethnic and socio-cultural backgrounds; in suggesting modifications in operational program design; and in attrition.

The analyses of the COII test indicated tendencies of mild changes in personal-social interests and in verbal factors. However, the value of and guidance derived from the analysis does not support the short-term use of the test.

Students did poorer in national tests in chemistry than in biology or physics. Twice as many students fell below the 84 per cent level than did national controls in chemistry. Chemistry scores were relatively consistent in 1965, 1966, and 1967, and also among the five teachers involved. This area should be investigated carefully for determination of the causes of the difficulty and possible methods of correction. For immediate consideration, in the absence of opportunity for further study, chemistry may be offered after physics, or only in the regular academic year. One observation, offered by teaching personnel, suggests that chemistry requires greater facility in mathematics than either biology or physics. Perhaps more concerted effort is required to ensure adequate mathematical training prior to offering chemistry.

Questionnaires did not indicate any clear cut extra effort of participating students in scientific hobbies or activities. One explanation may lie in the insensitivity of the instruments utilized. The data did show, however, that among the participants, a small group of students did manifest unusually intense scientific reading and hobby attention; there were more "outliers". The youth of the participants may militate against these students focusing major portions of their attention on science and diverting them to many other interests. Yet even at this age, a small core of already dedicated "scientists" are identifiable. A detailed study of this group, of its characteristics, background, motivational factors, and effective stimulants provides a most challenging and most promising area for developing lines for future planning.

Communication remains a continuing problem. Changes in school personnel, demand repeated orientation. Modifications in operating procedures and in minor policy matters necessitate frequent reorientation. Many teachers had little or no contact with the program, others were uninformed or disinterested, while still others were opposed to the concept of "enrichment" and/or "advancement" and/or interference with conservative, normal progress. These problems have remained, despite efforts to correct them. More effective methods of communication might profitably be explored. One approach might be inclusion of a unit on the program, annually in teachers' orientation and workship sessions. Other County School System policy recommendations could be effective. A third technique might be the designation of an appropriately qualified counsellor to coordinate the activities of the program with the academic year school problems of participating students.

Students were selected for participation in the project on the basis of matching pairs of participating and control students. By this technique, 40 students were selected annually from among the top 80 candidates. No doubt, the termination of the research aspect of the project will permit the selection of a higher overall level (e.g. 40 of the top 40 or 50, as desired). The project demonstrated that the individual WISC test can be used in selection, with a score of 120 serving as a flexible cut-off point. Flexibility is justified in view of the accomplishments of some of the students with lower scores. Only 4 A grades were issued to students with WISC scores of 120 and under.

Unfortunately, attempts to carry this project beyond the protocol requirements, particularly in regard to analysis of data derived from the structures interviews, were curtailed by the termination of this grant. Simple visual review indicate a number of suggestively helpful areas which might be useful on selection of students in the future, and actually in determining the effects of participation in the program in terms of at least four parameters, stress, self-concept, motivation (?), and inter-personal attitudes.

Perhaps a final conclusion should be stated. A great deal of thought and effort has been exerted in developing, executing, and evaluating the evaluation. No specific criteria of performing this last activity had been contemplated as a direct function. Yet we have the firm conviction (HOPE ?) that our hypotheses were reasonable, logical, and proper. Our first objective related to feasibility appears to be satisfied in an affirmative fashion. The second objective,

collecting continuous data, also has been quite well satisfied, but without further support, the true value of these data, and the failure to be in a position to analyse them will remain unproductive. The third objective, determination of the potential of the COII in the selection of students likely to follow scientific careers, was only partially satisfied. The follow-up revealed certain changing trends in interests, but these changes can not be considered definite based on the small number of observations, and the short period of these observations.

Recommendations:

1. One compelling thought pervaded the preparation and analysis of this report. Much "hard" data have been accumulated. Many lessons and much food for consideration have been presented. Great distress resulted from the abortion of the study. If any possiblity exists, further support, reactivation of the project and continuation of the evaluation are the basic logical steps for the future. Such extension will permit observation of greater numbers of students, greater observation time, opportunity for analysis of accumulated data on Rorschach and Bell Personality Inventory tests, and an overview of students from seventh grade selection time, at least through their high school careers.

2. The Dade County School System has expressed interest in continuing the operational portion of the program. Under such circumstances, economy, student selection, personnel allocation, curricular order and similar problems must be given prominent consideration. Because of such considerations and particularly because of the number of students who dropped from the program as a result of loss of interest, a revision in scheduling is recommended. This revision can be a reduction to three or even two summers.

3. Since participants in the program did well in BSCS and PSSC, but not so well in CHEM S, this course probably should be the first one to be transfered from the summer session to the academic year. Since the LO/I program must be operated in the rising eleventh summer, CHEM S may be offered in the tenth academic year.

BSCS may be taken in ninth grade in those junior high schools which offer it in their regular curricula. Students eligible for such classes in schools where BSCS is not taught, may be shuttled to the closest schools where they

can take the course (during the academic year), or provision for a summer class may be more feasible.

4. Since students did well in BSCS and PSSC, but not in CHEM S, a study is warranted to determine the reasons for their difficulties. CHEM S is offered the second summer, so that such possible explanations as first year inexperience or third year weariness (boredom ?) seem remote.

5. Greater depth of training in mathematics is imperative. The school science supervisors should pay more attention to the integration of the two disciplines. The staff of the program were impressed with the greater difficulty in CHEM S and PSSC among those students who were inadequately prepared in mathematics. A research design might be developed to investigate whether this impression is based on fact or opinion, and to investigate the substantive necessity for this interdisciplinary training.

6. Attrition requires in-depth investigation of all possible contributing factors. These include failures; loss of interest; out of town moves; development of other interests; civic, religious, athletic and other demands; weariness or boredom occasioned by deletion of four successive summer vacations; family problems; emotional upsets; and so forth. A study of all these variables would depend on a larger number of participants observed over a longer period of time.

7. Another study worthy of pursuit is a comparison of expressed motivational status of students participating in the project with other students in the same schools expressing interest in science.

8. Thorough study of the "communications problem" is warranted. Many areas of misunderstanding, and others of complete lack of information cropped up repeatedly. These areas have been manifest among parents, students, program teachers, guidance counsellors, and other school authorities.

Such a communications study should include attention to available techniques, pilot procedures, innovative trials, all in parallel with the degree of program need.

9. Procedural changes in student selection are recommended. In the absence of an intensive evaluation program, the requirement of selection from "matched pairs" is obviated. Thus, instead of selecting forty of the 80 most qualified candidates, the forty participants may be chosen by taking the forty most promising students. Other factors should be

considered in selection. Perhaps the most obvious and useful finding in this regard, is the significance of the WISC score. The data are in accord with the general statements that IQ and creativity or motivation or ability are not interchangeable. Nonetheless, a cut-off point of 120 for selection in the current study would probably have reduced appreciably the number of children lost to the program. Therefore, the use of the WISC and a cut-off point of 120 is recommended as a guideline, recognizing that exceptions to this rule may be permissible.

Should parental pressures, economic pressures, outside interests, expressed student goals be considered in selection? All of these factors appear to have played some role in the loss of students, but numbers within each category, and ability to study each student in depth, psychologically and sociologically, was not pcssible.

The effect of the specific teacher on his class, the interaction of teacher and student, the organizational and operational structure of the program, the infringement on four successive summer vacations, inability to take summer trips--all these factors remain to be clarified.

10. If a program of this type is contemplated, the planners should study carefully whether they wish to reinforce motivation of already science-oriented students, or whether they desire to attempt to attract to science, non-oriented students of average ability, or of above average ability. A program designed to accomplish all these aims will be complex and must recognize the need for provision of different milieus for each group.

11. Finally, the present project, evaluation of a program to promote scientific careers in gifted students at the secondary school level, has been successful in accomplishing immediate objectives, but its ultimate goal, that of evaluating motivational effects, cannot be reached without long-term study as originally designed. To reach this goal, without future duplication of effort, time and money already invested, continuation of the program is the sine qua non.

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION

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200 Saslaw, Milton S., M.D., M.P.H.

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ABSTRACT

800 Under NSF support, an operational program "Motivation in Depth for Gifted High
801 School Science Students" was initiated (1964). Specially selected seventh grade
802 students took BSCS, CHEMS and PSSC courses during successive summers after
803 seventh, eight and ninth grades; a newly designed curriculum, Laboratory
804 Orientation and Instrumentation after tenth, followed by eleventh and twelfth
805 academic years in the Laboratory Research Program (implemented in 1957). The
806 present USOE contract is to evaluate the operational project. Evaluation was
807 to determine program feasibility, collect data, and analyze the California
808 Occupational Interest Inventory (COII).
809 Feasibility was demonstrated by these observations: (1) 91.7 per cent of all
810 class performances met school requirements; (2) participating students in BSCS and
811 PSSC obtained scores on national tests more favorable than national controls; in
812 CHEM S the situation was reversed; (3) participants performed satisfactorily
813 compared with controls who took the regular academic program in tenth, eleventh
814 and twelfth grades.
815 Data have been collected over the duration of the program by individually
816 administered Wechsler Intelligence Scale for Children (WISC) and specially
817 constructed Structured Interviews, and by group Rorschach, Bell Personality
818 Inventory and COII. Analysis of the COII revealed only a significant increase in
819 the difference between experimental and matched control students in the personal-
820 social factor (decreased in participants).
821 The WISC appears to be an excellent aid in student selection.
822

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